

**MERGUS SQUAMATUS** Gould.

*Mergus squamatus* Ogilvie-Grant, Ibis, 1900, p. 602, pl. xii.

Two adult males of this handsome Merganser were shot in December 1908 on the River Min in central Fohkien out of a party of several individuals. One of these is in the Shanghai Museum and the other in my collection. I have another, also an adult male, shot in February 1911 in the same locality.

XIV.—*Some Notes and Observations on a Guan* \* (*Ortalis vetula*), suggested by an Examination of an Immature Specimen. By PERCY R. LOWE, M.B., M.B.O.U.

(Plate VII. and Text-fig. 1.)

SOME little time ago, while comparing some specimens of the genus *Ortalis*, which I had shot in Venezuela and southern Mexico, with those in the collection at South Kensington, I came across a very interesting specimen of an immature example of *Ortalis vetula* from the latter of the two countries mentioned.

If my interpretation of what this young bird teaches is correct, then the Guans (*Ortalis*) would appear to represent an interesting link in the chain of evolution of the life-history of a certain group of birds—in which chain we see at one end the primitive Hoatzin with its unique nidifugous young living an *entirely arboreal* existence, and at the other end the more nidifugous and very precocious offspring of the Megapode, which lays its eggs upon the ground in a mound of fermenting leaves and humus, and which now lives an *entirely terrestrial* existence.

Mr. Pycraft, who has made a special study of nestling birds, has graphically described the structural peculiarities observable in the young of birds at either end of this chain,

\* Pronounced locally *Gě-wān-n*.

and has ably interpreted their meaning. In a comparative review of the embryology of the common farmyard chick and other members of the game tribe, he has also indicated some steps in the path along which the descent from the trees to the ground was accomplished.

From the comparative security of the trees to the many hazards of the ground, whatever may have been the reasons which prompted such a departure, the way has doubtless been marked and punctuated by many intermediate developmental adaptations ; but of any of these intermediate stages among present-existing birds we seem to have discovered up to the present time no instances, or, at any rate, we seem to have ignored their existence.

In the case of the Guans (*Ortalis*), however, I shall hope in this paper to furnish evidence pointing to the conclusion that while the adult Guan lives an almost complete arboreal existence and has young *which are hatched in nests among trees and bushes*, and that while these young appear to live from almost their earliest days of immaturity the same precocious terrestrial existence which is seen in the case of our familiar game-birds, yet that this habit of nesting in trees which the Guan exhibits is *not an instance of a return to ancestral ways*, or, in other words, a case of reversion, but is, on the contrary, an instance among present-existing birds, which nest in trees, of an incompleting movement in the opposite direction—that is to say, towards the purely terrestrial life seen in many of the more modern types of game-birds.

In his 'History of Birds,' Mr. Pycraft quotes instances in which precocious young, specially adapted to meet the requirements of a terrestrial nursery, are hatched in trees ; and these instances he regards as examples of *reversion* to the old ancestral way, among birds, of a purely arboreal life.

Such examples are supposed to occur in the case of the Green Sandpiper, the Noddy and the White Tern, and certain species of Ducks. But these instances, I submit, are not comparable to the case of the Guans.

For while, on the one hand, the parents of the tree-bred young, instanced by Mr. Pycraft, differ as regards their external appearance and habits *in no way from their more orthodox or normal terrestrial or aquatic relations*, the parents of the tree-bred Guans present, on the other hand, not the slightest indication (suggested by structure, or general outward appearance) of their ever having led anything but an arboreal life; so that in this respect (as also in their tree-nesting habits, to which I shall presently refer) they would seem to form a group apart from all other gallinaceous birds.

Thus the absence of spurs\* and the low position of the hind toe or hallux in relation to the other toes seem both to be features pointing away from a former terrestrial life.

Again, the unicoloured and neutral tints which characterize the plumage of the Guans, in marked contrast to the generally variegated and patterned plumage of the purely ground-living game-birds, seem by reason of their harmony with the sombre shades of the trees to point to a long-continued arboreal life, or, at any rate, do not bear witness to a recent terrestrial† one. Both conditions of plumage are, of course, protective, but are protectively adapted to totally different kinds of environments, and between them we could hardly wish for a more striking contrast.

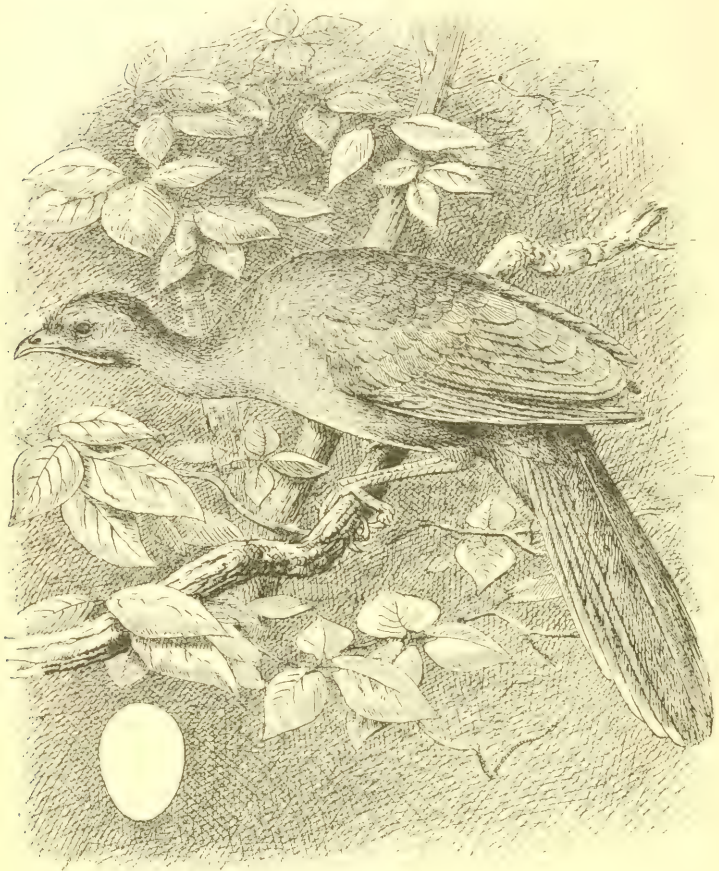
Moreover, the adult Guan in its general outward form and shape seems to present characteristics suggestive of a prolonged and purely arboreal existence, hardly less pronounced than in the case of the Hoatzin. By this arboreal stamp or impress I refer to the small, rather pointed, and Pheasant-like head, the long blunt-ended tail (adapted for balancing), the thin and rather long neck, the very attenuated and laterally compressed body (quite unlike the rounded body of ground-living game-birds, and especially

\* By this I do not mean to imply that all terrestrial game-birds have spurs, for we know that some have not.

† In making this statement I am aware of the peculiar fact that the Megapode by virtue of its neutral and unicoloured plumage is an exception.

remarkable when the bird is plucked), and the rather suaky appearance of the bird generally (much more noticeable when alive and in its natural environments), all of which

Text-fig. 1.



Adult example of *Ortalis vetula* with an egg drawn to scale.

features have evidently been evolved to enable it to easily insinuate itself between the dense complex of branches among which it lives, and stamp it with such an archaic impress.

Other instances of this purely arboreal stamp and archaic form occur to my mind, in the case of certain Neotropical Cuckoos, such as *Coccyzus* and *Saurothera*, which live an essentially skulking life in the densest thickets.

In these purely arboreal features then, which we have thus briefly referred to, we seem to see represented almost an exact antithesis of what obtains in game-birds which live continuously on the ground ; but if, as some might argue, this complete arboreal equipment has only been developed in an effort to *revert* to an ancestral mode of life, it seems strange that in the immense lapse of time which must have been necessary for its production, the Guan has not, at the same time, been able to completely lift, so to speak, its offspring from the ground to its new home among the trees.

Whether birds were originally *all* arboreal-living or *all* originally terrestrial-living, or even purely aquatic, which seems just as likely, appears as yet to be quite an open question ; but that the purely ground-living game-birds of the present day originally led an arboreal existence seems to be a fact beyond dispute.

If this is so, there must have been stages when the process of descent to the ground was not complete ; and my contention is that in the case of the life-history of the Guan we have such a stage represented in the present day.

#### *Nesting habits of the Guans.*

Before continuing our argument however, and before proceeding to the description of this interesting young specimen of a Guan, it may be well to bring forward evidence emphasizing the almost entirely arboreal existence which the Guans live (except perhaps for the possibly short period during which their young are living on the ground), and of the fact, of which I think we now have ample evidence, that they do nest in trees.

To take the nesting-habits first, I will quote the testimony of three observers, which should be sufficient for the purpose.

In a reference to *Ortalis ruficauda* on the island of

Margarita, Mr. Austin Clark ('Auk,' xix. 1902, p. 261) observes:—"The natives told me that this bird was common on the mountains; but I did not succeed in getting any there, although I found several nests which my guide attributed\* to this species. They were all about twenty-five or thirty feet from the ground and were large and bulky. One contained a fresh egg (July 9) which was unfortunately broken in being brought down to the ground."

Mr. Claude Grant, in a note on the habits of *Ortalis canicollis* in his paper on the Birds of Paraguay ('Ibis,' 1911, p. 461), remarks:—"On two occasions I saw the nest, which was placed in the topmost branches of a tallish tree and was a fair structure of sticks. According to the natives, the eggs are of about the size and colour of those of the domestic fowl."

Thirdly, referring to the young and nest of *Ortalis leucogastra*, Selater and Salvin quote the following ('Ibis,' 1859, p. 224):—"The chicks appear to run about *almost as soon as they are hatched* and display great agility in avoiding capture *by clinging † to the branches of the underwood.* (Italics ours.) The nest, composed entirely of small twigs, is usually placed in a low bush and contains two creamy-white eggs with rough shells."

To this very suggestive passage I shall refer later.

Finally, Mr. Collingwood Ingram, as the result of a recent visit to Tobago, has kindly furnished me with the following notes on *Ortalis ruficauda*, which, at my request, he took great pains to collect from various sources on the spot:—"The nest is usually placed in a tangled thicket of creepers

\* I have myself seen Guans, which had been caught alive, in Margarita. The bird is well known to the natives there, and is domesticated. It is therefore very unlikely that Mr. Clark's guide could have made any mistake, more especially as there are no birds on the island (in the high woods where the Guan occurs) likely to build a similar nest. The large size and colour of the egg found would also preclude any mistake.—P. R. L.

† The word "*clinging*" used by the field-observer is worth noting.—P. R. L.

and vines, &c., about six feet or more from the ground, *never* actually thereon. All my informants were agreed upon this point. It is built of twigs, small sticks, grasses, &c., and is never a mound of dead leaves suggesting a megapode. The young, hatched out by domestic fowls, are said to behave very much like young game-birds until about 14(?) days old, when they will enter trees or bushes or even climb on to the roof of a low building. In the wild state they are said to leave the nest almost at once. Two eggs appear to be the usual number laid."

#### *Arboreal habits of the Guans.*

As regards the almost entirely arboreal existence led by the old birds, every writer who has had anything to say on the habits of the bird emphasizes this point.

I have myself often observed the Guan in Mexico and Venezuela, and I cannot remember ever having seen one on the ground, although I have seen and heard a great number in their natural habitat among low trees and dense scrub. There is, however, I believe, no doubt that they do sometimes descend to the ground.

Mr. Graham Kerr ('Ibis,' 1892, p. 148), speaking of *O. canicollis*, says, for instance, "They occasionally descend to the ground to feed; but this is comparatively rare."

Guans are indeed, as a matter of fact, timid and sociable birds, which live in small parties below the dense umbrageous foliage of thick and tall bushes or low trees. In Venezuela (*O. ruficauda*) I have met with them in low-lying country covered with dense scrub, or in the thick bush surrounding occasional clearings in the dark and solemn forest.

On the eastern coast of Mexico, where *Ortalis vetula* occurs, I have seen them in dense scrub, where it was very difficult to track them down; or, again, flying across the backwaters of rivers (with much the same feeble and ineffective flight as is described as characteristic of the Hoatzin) from one dense mangrove or other variety of

jungle to another, where it was quite impossible to follow them. This they only did at sunrise and sundown, when they proclaimed their presence by their discordant choruses.

In southern Mexico, in the dense forests which border the smaller tributaries of the Coatzacoaleos, I have once or twice observed small parties in the thick and lustrous green trees which fringed the streams.

Their flight, as I have hinted, is short and feeble, and, unless under great provocation, they display a marked disinclination to take wing. When they do so, they nearly always leave their shelter on the side directly opposite to that from which the observer is approaching; so that the latter seldom has the chance of observing their escape to quite a neighbouring bush. Indeed, on several occasions on which I have observed this habit, I have been unaware that the birds had left the retreat in which I had marked them down, so silently and craftily is their departure made.

Moreover, if it were not for the noise they make at sunrise or sunset or when seriously alarmed, the presence of these birds would seldom be suspected owing to their unusually silent and secretive habits amidst the thick bushes at other times of the day. On the approach of an intruder, one or two birds out of the band occupying a bush or low tree will often descend to the lower leafless branches, from whence they can obtain a more extended view of their surroundings. If reassured, they will then hop upwards, as I have myself observed, from branch to branch and rejoin their fellows in silence. If more suspicious, the whole band, after a few notes of warning from the leader, may burst into the most discordant notes of alarm; after which they will probably, one by one and very silently, take their short and generally unobservable flight to a neighbouring retreat.

On several occasions, when quite unaware of the near presence of a flock of Guans, I have been considerably startled in the gloomy silence of the forest by this sudden hullabaloo, occasioned by perhaps half a dozen birds suddenly breaking out into loud cries of alarm.

Rendered into words, the nearest approach to the chorus



with which the Guan (*Ortalis vetula*) greets the sun in the morning and bids farewell to it in the evening, is as follows:—

Catārh-kätt̄r-k̄r-rāh ; Catārh-kätt̄r-k̄r-rāh, quickly repeated half a dozen times in a sort of gobbling chorus. The cries are very resonating, as may be easily understood by anyone who takes the trouble to merely pluck the breast of a male bird and expose the then easily visible trachea, which is bent in a long loop upon itself and lies for a great part of its length outside the thorax and immediately beneath the superficial fascia of the pectoral region.

Conformably with its arboreal mode of life, the food of the Guan appears to be chiefly confined to the leaves of certain trees and bushes. What particular species are preferred I am unable to say; but in southern Mexico I once shot a bird out of a flock of some half dozen or so, which I had observed in a tall bush with rather vivid shiny and glossy leaves. The stomach of this bird was packed tight with an almost dry mass of the finely divided leaves of the bush in which the bird had been shot. They had an appearance as if they had been chopped up with some sort of machine. The fruit and seeds of trees and bushes are also said to be eaten.

These pronounced arboreal habits, taken in conjunction with the skeletal features which distinguish the Cracidae in general from the more modern game-birds, and the fact of the great and extraordinary persistency which has characterized birds in general through immense periods of geological time, make it difficult to believe that a bird which, we must presume, started its career as a tree-dweller, could then adapt itself to an existence on the ground and then again revert to a life in the trees.

Rather, it seems to me more likely that the Guan long ago arrived at a blind alley of evolution and has failed, and will fail, to progress. It is simply marking time. It has probably never been exposed to conditions which differ very greatly from its present existing ones, and so there have

never been conditions in its surroundings potent enough to make a descent to the ground a permanent necessity.

It is interesting to note, however, that in Texas, the most northerly limits of the Guan's distribution, and where the conditions are very much drier and consequently the vegetation infinitely more scanty, "the birds are said to nest in the heaps of leaves accumulated under the Mesquite-bushes" (*cf.* Boucard, P. Z. S. 1883, p. 460). If this is true, it seems to illustrate a further step in the descent to the ground, induced by altered conditions of environment.

The fact that the young, as we shall later see, live upon the ground, while the adults spend their existence in the trees, seems to point to the fact that the Guan has either failed to completely adapt itself to one or the other environment, or that there has never arisen the necessity to do so.

In a most interesting account of the habits of the Hoatzin, Mr. Beebe, in 'Our Search for a Wilderness,' remarks:—"Inexplicable though it may appear, the Hoatzin—although evidently unchanged in many respects through long epochs—yet is far from being perfectly adapted to its present environment. It has a severe struggle for existence, and the least increase of any foe or obstacle would result in its extinction."

Indeed, except that the Guan has apparently made one step downwards to the ground, it reminds us forcibly, in point of diet, habits, and ways generally, of the Hoatzin, which is essentially a primitive type of bird addicted to an almost complete arboreal existence (*cf.* J. J. Quelch, 'Ibis,' 1890, p. 327).

#### *Some structural features of the Guan.*

To some it may appear venturesome thus to compare the Guan and the Hoatzin; but in many respects the latter bird presents structural features distinctly pointing to its affinities with the Gallinæ, and perhaps in none more so than in its well-differentiated cæcal colon; for it will be remembered that the ileo-colic region reaches its highest state of specialization in birds which live mainly on a purely vegetable diet.

Dr. E. A. Wilson, for instance, has drawn attention, in "The Grouse in Health and Disease" (Report of the

Committee of Inquiry, 1911), to the fact of the special selective function of the cæcal colon in this bird, whereby the rough fibres and undigested debris of heather and other vegetable matter, present in the alkaline chyme when it reaches the specialized colic cæcum, are passed on through the sphincteric tract to the colon; while the more fluid contents are pressed back into the cæca proper, where they undergo an acid digestion through, probably, the agency of bacteria.

Garrod, again, referring to the osteology of the Hoatzin (P. Z. S. 1897, p. 109), says: "I may, however, mention that it is only in the Cracidæ, among allied birds, that the vomer runs so far forward in the palate, at the same time that it is tumified at its anterior extremity. In *Ortalis albiventris* this is most strikingly the case."

Again, he goes on to say: "The presence of two carotid arteries, an ambiens muscle, an accessory femoro-caudal, and a deep plantar vinculum place its non-passerine nature beyond a doubt. Adding the tufted oil-gland and the inch-long colic cæca, the bird could only be related to the Tinamidæ, Gallinæ, or Rallidæ,"

That it can have nothing to do with the Rallidæ is evident from the fact that *Opisthocomus* is holorhinal, and Garrod concludes that it must therefore be a Gallinaceous bird or form a group by itself. He adds, that "as there is no Gallinaceous bird without a direct articulation between the pterygoid bones and the basi-sphenoidal rostrum, it is hardly possible to include the Hoatzin along with them; and yet it resembles them most clearly, as it does the Cuculidæ, in the length of its colic cæca and the number of its rectrices." Indeed, as he suggests, it would appear very probable that *Opisthocomus* left the parent stem very shortly before the true Gallinæ first appeared.

#### *Description of a young bird,*

This specimen, which is labelled *Ortalis vetula* (Wagl.), Mexico, Cuesta de Misantla, Junio 1888, No. 91. 10. 21. 276 (Salvin-Godman Coll.), is in the collection of the British Museum and is figured on Plate VII.

I think there can be no doubt that anyone examining this juvenile example of *Ortalis vetula*, offhand and without any previous knowledge of what it actually was, would be struck at once with its striking resemblance to the young chick of a "game-bird," and more especially as regards its wings to that of a Pheasant.

A slightly more critical examination would produce the impression that it was a young "game-bird" whose wings and tail had outgrown, so to speak, the rest of its body, or, in other words, whose remiges and rectrices had far outstripped the rest of its plumage in development towards an adult condition.

The head, neck, and body generally, both above and below, are covered with a thick, soft, long and closely disposed down.

This downy plumage on the underparts is more or less unicoloured, the coloration merging from a deep rufous tint on the foreparts of the neck and breast into a pale whitish buff or buffy white over the abdomen and crissum.

The upper parts, on the contrary, present an appearance which we are accustomed to associate with a coloration adapted for purely protective purposes, as is seen in nestlings which are nidifugous and whose parents lay their eggs on the ground (Game-birds, Plovers, Gulls, etc.).

Thus there is, running along the top of the head in the median line, a long stripe of pure black, which extends from the frontal region to well down upon the back of the neck and thence down the median line of the body.

There is a tendency to longitudinal striping on the sides of the head, and the same tendency, but in a more marked degree, is seen upon those parts which are covered by the wings when folded.

The ground-colour in these latter parts is of a light buffy tone, with a tendency to a deep reddish brown along the middle of the lower third of the back.

The seven innermost primaries, the secondaries and tail-feathers, in marked contrast to this general downy plumage, are, as we have previously mentioned, relatively greatly advanced in development, and as regards the general

disposition of the colouring and markings on them, the resemblance to those of a young Pheasant is most striking.

There is no need here to go into more detail in regard to this coloration ; but a point to be noticed is the pale buffish tips to all the remiges.

Another interesting point to be noticed is that the tail-feathers and all the coverts bear more or less conspicuous prepennal down-feathers (*mesoptyles*). In the case of the median coverts, these prepennæ form quite a conspicuous band or edging which is nearly a quarter of an inch wide (averaging 13.5 mm.) and is of a strong buff or rufous tint. They are only just visible here and there on the tips of the greater coverts.

It is also to be remarked that the feathers which compose the lesser coverts are far less perfectly developed than are those of either the greater or median coverts.

The rami or barbs of these lesser coverts are of the "discontinuous" order and of a more downy nature, although there is a distinct enough rachis.

The scapular feathers are similarly of the same undeveloped or degenerate nature, and in both these and the lesser coverts we seem to have presented to us a stage in the evolution of plumage intermediate between a general downy plumage and the fully developed feathers of the wings and tail.

Finally, we must call attention to the *arrested development of the outer primaries*, a most interesting reminder of a primitive arboreal nursery-life (which in the case of the Hoatzin Mr. Pycraft was the first to bring to the notice of ornithologists); and also to the absence of any visible or tangible evidence of claw-like appendages to the extremities of the manus\*, such as are seen in the young Hoatzin in post-embryonic life; while another remarkable feature is the very large size and thickness of the feet and claws, almost twice as heavy and "coarse" as in the case of a

\* I have since found in the British Museum collection another and younger chick in which claws can be distinctly felt and seen on the thumb. This was in a young example of *Ortalis cinereiceps* (Gray) from the Cordillera de Tole, Veragua.

young Pheasant of about the same age, with which I compared it.

We thus see that the chief and most striking features to be noticed in regard to this young Guan is a combination of a downy body-plumage, protectively coloured, with a far more than ordinary precocious development of the flight-feathers.

In addition, there seems to be apparently displayed in this one example a sort of epitome of the evolution of feather-development.

#### *Conclusions.*

Obviously then, the plumage of this young tree-bred Guan presents characteristics which we are now accustomed to associate with the precocious or nidifugous type of nestling.

But while still showing the arrested development of the outermost primaries, reminiscent of an ancestral and complete arboreal existence, the protectively-coloured down plumage, combined with the accelerated development of the rest of the flight-feathers, marks it as a young bird adapted for a terrestrial existence in the early days of its life.

As we all know now, this protectively-coloured down must have been evolved to enable it to harmonize with its surroundings on the ground; and the advanced development of the flight-feathers must likewise have been found serviceable in order to furnish means for the young chick, not necessarily and solely to escape its many enemies in a precarious environment, but also to enable it to make a more effective pursuit of the many small moths and flying insects which fluttered and flew among the herbage wherein it passed the first days of its life. And this it could do by being able to give small jumping flights into the air, even if it was not actually able to fly for a few feet.

At the present time no observations have been published to enable us to say exactly how long a time elapsed from the day when this chick first saw the light of day in its nest among the trees to the day when its parents first conducted it to the ground.

If, however, we can draw any conclusions from the very large size of the Guan's egg in relation to the very small size of its actual body when stripped of its feathers, then we should be tempted to say that this period must have been reduced to very small proportions.

This disproportion between the size of the bird's naked body and the egg is so great that one wonders how a bird of such slim proportions could possibly lay such a large one.

In other birds, such as the Megapode, it has been recognized that disproportion of such a nature has been evolved in order to allow of the whole of the normal period of the nestling stage to be got through within the shell before the young are hatched ; by which it comes about that the young Megapode from the moment of hatching is fully fledged and can fend for itself.

Taken in conjunction with the remarks made by Selater and Salvin in reference to the habits of the young of *Ortalis leucogastra* (*loc. cit.*), the large size of the Guan's egg seems therefore to justify us in concluding that the young Guan at the moment of hatching is in a very advanced condition of development ; and that with such a precocious condition of the inner flight-feathers descent from the tree to the ground at a very early stage in its life-history would be rendered comparatively easy.

The fact of the retarded development of the outer primaries and the statement in regard to the agility displayed by the chick in *clinging to the branches of underwood*, is also of great interest, as being reminiscent of ancestral days when it was in all probability entirely arboreal in its habits.

Geological evidence all points to the fact that the further we go back (within limits) the greater proportion of carbon dioxide there probably was in the atmosphere and the greater the density of vegetation ; and it appears to me that those who might hold that the Guan is only in process of again *reverting* to an arboreal existence could only do so by presuming that at some past geological epoch there must have been a sudden retrograde movement in the amount and

density of the vegetation on the South American continent, leading to such general conditions that it was more profitable, or indeed compulsory, for the Guan and its congeners to temporarily forsake their arboreal retreats and to descend to the perils of the ground.

To my mind it seems more probable that this attempt to descend has only taken place in comparatively recent times, since the days when we know that vegetation has been generally tending to diminish. A further possible explanation, which is, of course, purely hypothetical, of this more recent tendency to descend to the ground might be sought in some danger to the chick in the trees, such as a gradual increase at some past epoch in the prevalence of tree-snakes. I have on several occasions seen tree-snakes attacking birds, and anyone who has watched a pair of parent birds noisily defending their offspring from the slow and deadly advance of these murderous assailants would allow that such a condition of things as I have suggested might quite possibly have been enough to start the process of a descent to the ground.

Other facts which occur to me as being against reversion are :—

(1) The white (non-protective) coloration of the Guan's egg seems rather to point away from a previous terrestrial existence \*, for "It is almost certain," says Mr. Pycraft in his 'History of Birds,' p. 207, "that the eggs of the earliest birds were white, like those of their forebears the reptiles; and further, since these primitive birds were arboreal, that they were laid in holes of trees or under cover. Later, when some migrated from the forest region to the plains or meadows, colour became necessary; firstly for protective purposes, and secondly, probably, as a defence against the action of light, which in excess is inimical to protoplasm."

But granting that this is true, which seems probable, then those who hold that the arboreal existence now led by the Guans (*Ortalis*) is an instance of reversion must also agree

\* Tree-Partridges, on the other hand, also lay white eggs.



to what appears to me to be a very improbable hypothesis, viz., that their eggs were first white; then, as the result of a migration to the ground, coloured; and, finally, as a result of a reversion to their original arboreal life, again white.

(2) The fact that in the case of the Curassows and Guans only two eggs are said, as a general rule, to be laid, also seems to point away from a previous terrestrial existence on the part of the adult birds. Most ground-living game-birds lay clutches of eggs which contain a far greater number, presumably to allow for the greater liability to accidents.

(3) Capercaillie, Blackgame, and other such-like game-birds in adult life still spend a good deal of their life in trees, feeding on young shoots, although they nest on the ground and their young are protectively coloured and provided for.

If I understand Mr. Pycraft aright, this would indicate an attempt on the part of these birds to revert to a former entirely arboreal existence. According to my contention, it is rather evidence of an *incomplete descent* to the ground, a state of things arising in the past from the exigencies of local conditions (*e. g.*, vast tracks of pine, larch, and spruce trees, and consequent cramping). In our Red Grouse and Partridge and in the Quail the process may be considered as complete. It is also suggestive to note that in the game-birds as a group, although the nestlings are generally prone to longitudinal stripings, yet when we come to trace these markings from the more primitive to the more modern types the stripes tend to break up into mottlings. Such a condition of things can be roughly traced, for instance, in a series such as the following—Curassow, Guan, Peacock, Blackcock, Capercaillie, Pheasant, Partridge, Red Grouse, Ptarmigan; where a progressive descent to the ground seems to go nearly hand in hand with an increased mottling, or *vice versâ*.

(4) In regard to birds other than those belonging to the Gallinaceous order, Mr. Pycraft (*tom. cit.* p. 247), referring to the Gannets, Cormorants, Frigate-birds, and Pelicans, says: these “now, either sporadically, or in the case of

some species constantly, nest in trees. Such a nesting-place doubtless has only lately been resorted to—it is a *reversion to an ancient custom* [italics ours] and not a survival, as in the case of the Hoatzin.”

In the West Indies I am acquainted with the nesting-habits of three Gannets. One of these, *Sula piscator*, invariably nests in trees; but two, viz. *S. cyanops* and *S. sula*, invariably nest on the ground. Yet all three have helpless naked young in the early stages of the nestling period; and it seems to me that it might just as well be argued that originally all Gannets nested in trees; that *S. piscator* has never done anything else; and that in the case of *S. cyanops* and *S. sula* the descent to the ground has been of comparatively recent origin, consequent upon the more arid conditions of their nesting-sites and a gradual and progressive diminution of a lush vegetation in comparatively recent geological periods.

Knowing, as we do, of the far greater widespread prevalence and luxuriance in past ages of the mangrove-plants (Rhizophoraceæ) and mangrove associations—among which *S. piscator*, tropical Cormorants, Frigate-birds, and Pelicans seem to nest *for choice*—I must confess that this last argument appears as worthy of consideration as that which supposes that the arboreal nesting-habit of *S. piscator* is a case of reversion.

But perhaps we have said enough in support of our thesis that in the life-history of the Guan we seem to have at least illustrated among tree-nesting birds an intermediate and living link in the chain of evolution of nidifugous habits, which chain, as Mr. Pycraft has pointed out (Proc. IVth Internat. Ornith. Congr. 1905), began on the one hand with the reptilian method of progression seen in the young of the Hoatzin, and ended on the other with the precocious potentiality for flight (and a complete descent to the ground) as seen in the case of the Megapode and its young.

It may possibly be that some of the facts brought forward, illustrative of the life-history of this most interesting and primitive game-bird, could be interpreted in a contrary sense,



YOUNG GUANS (*ORTALIS VETULA*).

West, Newman proc